

# iMoS: Intelligence Monitoring System of HIV Carriers in Thailand

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## ABSTRACT

The World Health Organization (WHO) launched universal strategy in HIV prevention in 2012 called “Test & treat HIV prevention”. (iMoS) Intelligence Monitoring System is developed a prototype in order to be a monitoring platform to support the medical treatment of HIV carriers by integrating information technology approaches in fields of database, communication, and mobile application. iMoS consists of three main modules: 1) The clinical module; 2) The laboratory module; and 3) The monitoring module that transfer data with each other on computer network. The Clinical module is a front office to collect a client data and medical record form registration process. The risk assessment data is fed into database by consulting process. The Laboratory module is scientific machine section to perform testing Anti-body HIV and CD4 testing with international standard to complete medical data. Morning module is the front-end application to contract with HIV carriers using wearable mobile device under privacy policy. It is important to take standardize monitoring HIV carriers by using information technology platform. The iMoS is intended to implement all HIV carriers in order to reduce new HIV infection and get into prompt medical treatment.

**Keywords:** HIV, Monitoring System, Thailand

## I INTRODUCTION

Human immunodeficiency virus (HIV) is a global healthcare problem. Most than 7,000 people are newly with HIV infected every day. No country has escaped the devastation of this truly global epidemic (UNAIDS, 2011). Thailand is developing country which in public health policy has been effective in preventing the transmission of HIV on national scale (UNAIDS, 2014b). Thai Government is funded to support prevention program have saved millions of lives, reducing the number of new HIV carriers from 143,000 in 1991 to 9,700 in 2011. There are 490,000 people in Thailand are HIV carriers, and 23,000 people died from AIDS-illnesses (UNAIDS, 2014a). The first case of AIDS in Thailand occurred in 1984 (Phanuphak, 1985). The Thai Red Cross AIDS Research Centre (TRC-ARC) officially began operating in December 1989. TRC-ARC founded the Anonymous clinic provide medical services such are

to blood checking, advising on diseases transmitted through blood and sexual intercourse like AIDS, syphilis and hepatitis B (Phanuphak, 2014a).

The ‘Test & treat; New Strategy in HIV Prevention’ project conducts by The Ministry of Public Health’s Disease Control Department and TRC-ARC launched since November 2012. The project conducts in homosexual and transgender population and pilot provinces: Bangkok, Lampang, and Ubon Ratchathani. The project is expanded into all newly HIV positives and risk groups such as injecting drug user, men who have sex with men (MSM), migrant workers, and sex workers (Phanuphak, 2014b). A strategy of universal HIV testing for person aged > 15 years and immediate administration of antiretroviral therapy for those found to be positive. In South Africa, the researcher use mathematical model to predict the number of new HIV infection. The result show rapid reduction to less than 1% within 50 years (Granich et. Al, 2009). All Thai people eligible for treatment receiving follow the World Health Organization (WHO) guidelines of initiating antiretroviral drugs (ARVs) at CD4 all levels.

Viral load refers to the amount of HIV in the blood. If the viral load is high, T-helper cells tend to be destroyed more quickly. Therefore, the aim of antiretroviral treatment is to keep the viral load as low as possible. Monitoring system is recommended to be based on viral load, rather than CD4 count, because it provides greater accuracy of test results. The current WHO treatment guidelines recommend that a viral load test is carried out at 6 months after treatment begins, at 12 months, and then every year. If the treatment is working effectively the viral load will drop to an undetectable level below 50 copies/ml. Ideally this will happen within 24 weeks of starting treatment, but for some it can take 3 to 6 months. On the other hand, some people never reach undetectable in which case alternative regimens can be started if necessary. (UNAIDS, 2012).

Tracking system is importance to keep tracking of HIV carrier progress and medical treatment status. TRC-ARC updates status of all clients. HIV carriers can gain benefit from tracking system since they can get useful information for eligible of medical treatment. Generally, tracking methods include hardcopy letter, telephone, short message service, and door-to-door. (Wu et. al., 2012).

In this paper, we design monitoring system based on ResearchKit under TRC-ARC procedure on service operation and laboratory result operate under international standard. The system could gather client information, perform medical testing, and provide HIV carriers report to tracking process. All service processes operate under protecting the privacy of client. The hold of the paper is organized as follows. Section 2 introduces the framework of the monitoring system. Section 3 describes Monitoring system. Section 4 experimental method, and Section 5 shown researchkit framework and section 6 conclusion our work and shows future develops.

## II MONITORING FRAMEWORK

### A. Conceptual Framework

Fig. 1 shows the structure of Intelligence Monitoring system (iMoS). The iMoS consists of clinical module, laboratory module, monitoring module, and front-end devices.

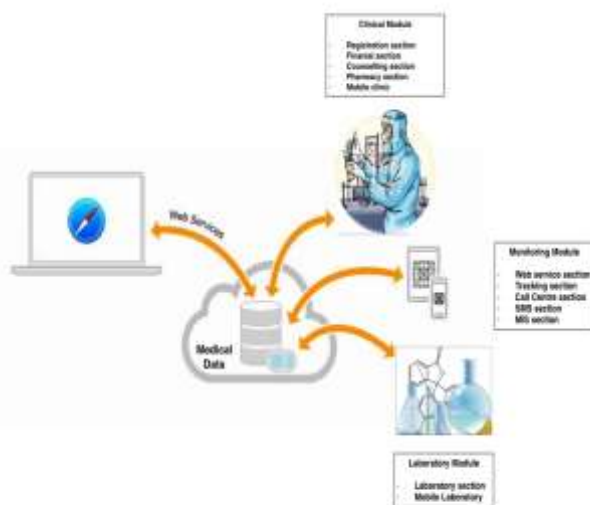


Figure 1. Intelligence Monitoring System.

*Clinical module* is front office that mainly responsible for register all clients. HID (Hospital Identification) is assigned to new clients. Clients fill personal information to application form and they can concealable personal information. Clients consulted by professional consular assessed risk information, consulted psychological process and assigned laboratory testing order to client.

*Laboratory module* conducts HIV testing and CD4 count (Cluster of Differentiation 4) (UNAIDS, 2013) by healthcare professional who takes a blood sample from the arm or finger. In Thailand, TRC-ARC combines three methods of tests that are used to find out whether HIV carriers; HIV antibody 4th generation test, NAT (Nucleic Acid Amplification Testing) and RNA

*Monitoring module* responsible for gathering medical data and update HIV carries status. Medical data include personal information, HIV test date, available time, affiliation, phone number. HIV carrier status consists of HIV testing and CD4 results start date of medical treatment, hospital name and monitoring records.

*Mobile network* is the medium that can carry multi-media and information such as voice, Short Messaging Service (SMS), e-mail, world wild web, social media, VDO conference contract between the monitoring system and the HIV carriers. Every people can access or push information from their wearable mobile devices. However, the HIV carrier can use the monitoring system only after their permission.

*Wearable mobile devices* are end terminals. These devices can be smart-watch, smartphone, computer-tablet and laptop computer. The wearable mobile devices are operated under several kind of platforms are iOS, android, windows phone, blackberry etc. Mobile application is important software that can serve user to access huge information.

To summarize, the monitoring system retrieve information from the clinical unit and HIV testing and CD4 results form the laboratory unit. The monitoring system provides medical services for HIV carrier though mobile internet and mobile devices.

### B. System Flowchart

Professional counselor initiate counseling and testing model (PICT) to identify HIV risk levels. (Sibanda, 2009). The healthcare professional takes a blood sample from the arm or finger for HIV anti-body test. About 1 hour after the blood-test, counselor will again call client to give HIV the result for HIV test. (TRC-ARC, 2013a). If result of HIV status is positive, counselor has to con-firm the result and sign acceptance monitoring form. HIV carriers are contracted after HIV testing two weeks. Monitoring method depends on their acceptance such as phone call, SMS, e-mail. Medical treatment is the most importance data that have to record in to the system. Hospital name, medical treatment period, CD4 result will be recorded and prepare for the next monitoring.

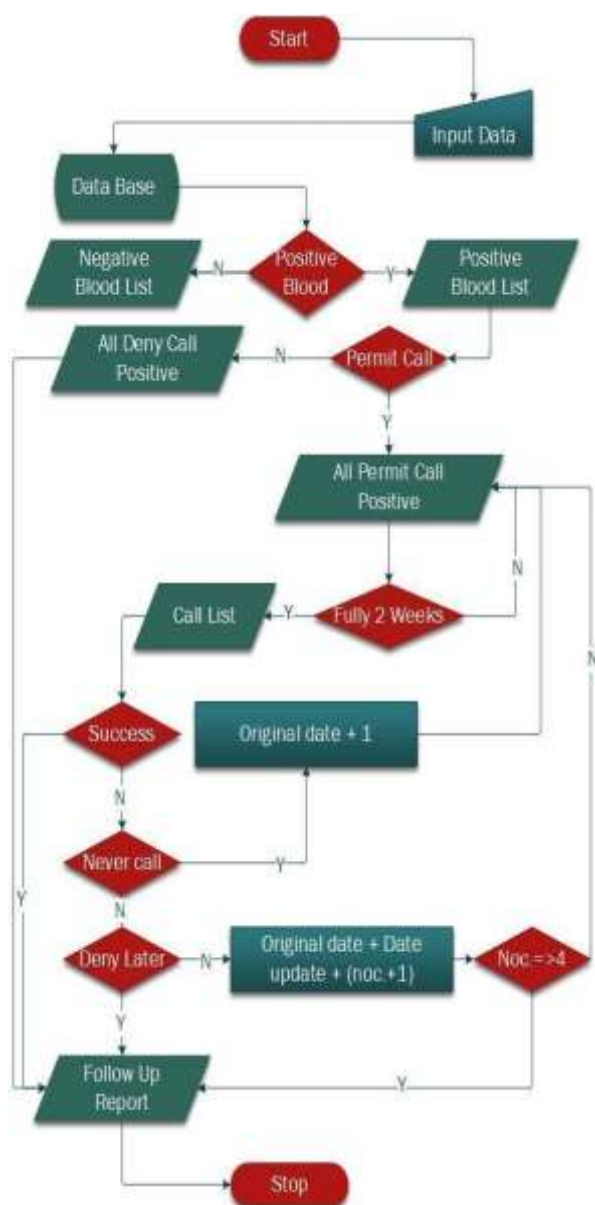


Figure 2. System Flowchart.

### III INTELLIGENCE MONITORING SYSTEM

*The Clinical Module.* Anonymous Clinic service client under protect and privacy policy. There are five section follow. Registration section support clients data to provide personal information. Financial section manage cash system and billing. Counseling give pre-test and posttest result to client. Pharmacy section distribute medical supply to clients. Mobile clinic provide service to target area.

*The Laboratory Module.* Professional Medical technical take blood sample. Blood or specimen is collected seven milliliters of blood in an EDTA-treated tube (to prevent it from clotting), and have the tube sent to blood test machine. All process spends one hour to report HIV test. There are two kind of

laboratory follow. Laboratory Section get specimen to test Anti-HIV, CD-4 and other specific result. Mobile Laboratory operate with mobile clinic.

*Monitoring module.* The monitoring system is the module is created to support "Test and treat prevention program". All HIV carriers have to monitoring under WHO treatment guidelines. Medical treatment, viral load and CD4 count provides greater accuracy of test results within 24 weeks. Monitoring modules consist of web service section provide platform service. Call Centre section support client and provide service information. Management Information System section process properly information to all level employee. Monitoring section maintain infrastructure for monitoring system.

### IV EXPERIMENT METHOD

*Design of System.* iMoS consists of medical data center that store all information of clients and other attached facilities. The system is divided into three modules, which are the clinical module, the laboratory module, and monitoring module. The clinical module contains basic medical data form client and supports daily medical services. Respond time is the key main factor to design physical system. The laboratory module provides medical results under international standard. Reliability is the pivotal in this module. Medical devices of Third party have to compatible with main system. The monitoring module contracts to all HIV carriers with variety kind of methods. Accessibility is the importance to tracking all clients.

*Design of Sample.* We collected data form the clinical modules since 2010 -2015. Table 1 shows demography of each result will be analyzed in order to use properly method to monitoring.

Table 1. Demography of Client.

Item	Detail	Numeric
Gender	Male	80 %
	Female	20 %
Age	Average	29.8 years
	SD	13.4
Visiting	First Time	13.65%
	Monitoring	78.2%
HIV Status	Positive	93%
	Negative	7%

\*Number of patient = 174,117

### V RESEARCHKIT FRAMEWORK

The ResearchKit framework is an open source software framework to create research applications on iOS. This framework takes advantage of sensors and capabilities of iOS device to track movement, take

measurements, and record data. Users can perform activities and generate data from anywhere. There are three customizable modules that address some of the most common elements of research: surveys, consent, and active tasks.

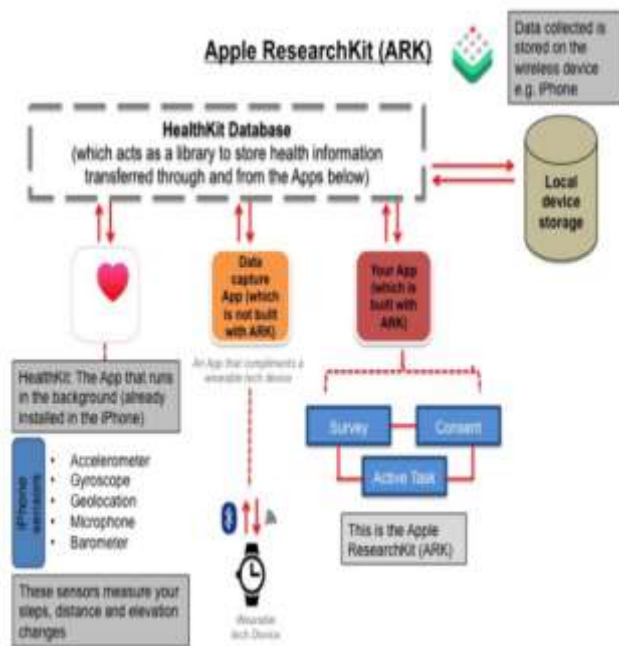


Figure 2. ResearchKit Framework.

*The survey module* predefined user interface lets you quickly build surveys simply by specifying the questions and types of answers. The survey module is already localized, so all you need to do is localize your questions.

*The consent module* in research studies are sensitive information as part of their enrollment and involvement in the study. It is critical to clarify exactly what information will be collected from users and who will have access to their information.

*The activity task module* is provided by responses to survey questions or the data collection capabilities of APIs on iOS. Active tasks invite users to perform activities under partially controlled conditions using iOS device sensors to actively collect data following.

## VI CONCLUSION

The number of HIV carriers and their monitoring data increase rapidly. Traditional monitoring methods are not effective enough. To fill the huge discrepancy, we proposed Test and Treat monitoring system. The system consists of Clinical, Laboratory, and Monitoring module. This Monitoring system is developed using ResearchKit on iOS device and help the TRC-ARC to know more about HIV carriers' states of medical data. At the same time, the doctor and researcher could track in a convenient and

efficient way. The future improvements of this work can be done in several ways. First, we develop with wearable devices. Second, the HIV carriers have to have a check-up and then fill in the mobile application by hand at present. We can use sensors device to monitor the HIV carriers's condition in real time. Third, more security measures should be applied to protect privacy policy and other unauthorized access. Successful completion of this research will hopefully empower form TRC-ART to support HIV carriers. Future work aims at developing web application for call center section and a mobile application that would provide tracking data in the same manner.

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